Title:

Bayesian Networks for Robust and Interpretable Object and Intent Classification of Airborne Targets

Multisource Data Fusion with Bayesian Networks for Robust and Interpretable Object and Intent Classification of Airborne Targets

Abstract:

Despite advances in sensing technology, the challenge of tracking, identifying, and determining intent of airborne objects increases in difficulty as we face a myriad of air threats ranging from legacy aircraft to next-generation coordinated unmanned systems and emerging hypersonic threats. Coupled with improvements of deception technology, shortcomings of existing sensors, and inconsistencies between sensor readings, the question remains: how do we produce the most accurate understanding of the battlespace despite these challenges? Previous work in target tracking, identification, and classification has sought to improve efficacy of individual sensors, or to perform data fusion at the lowest level possible between sensors. However, these approaches neglect to address higher level interfaces between distinct sensors and tracking algorithms initially designed to operate as self-contained systems. In this work we present a novel Bayesian network architecture template capable of producing high fidelity target and intent classifications conditioned by observations of the battlespace and prior knowledge of sensor reliability. We achieve this through a holistic approach to target tracking and identification, seeking to relieve dependency on individual sensor units and to leverage all possible information of the battlespace, especially human level knowledge of sensor behavior, battlespace conditions, and enemy force. We find that Bayesian networks are favorable tools to encode domain knowledge and perform last-mile reasoning over any number of non-explainable black-box type approaches, producing more reliable, trustable, and interpretable results than any individual sensor.

Keywords:

Multisource data fusion, object recognition, intent classification, behavior analysis, Bayesian networks, explainable AI

What am I doing?

In this work we present a novel Bayesian network architecture template capable of producing high fidelity target and intent classifications conditioned by observations of the battlespace and prior knowledge of sensor reliability.

What is my approach?

We achieve this through a holistic approach to target tracking and identification, seeking to relieve dependency on individual sensor units and to leverage all possible information of the battlespace, especially human level knowledge of sensor behavior, battlespace conditions, and enemy force.

What are my results?

We find that Bayesian networks are favorable tools to encode domain knowledge and perform last-mile reasoning over any number of non-explainable black-box type approaches, producing more reliable, trustable, and interpretable results than any individual sensor.

Online Abstract Summary:

In this work we present a novel Bayesian network architecture template capable of producing high fidelity airborne target and intent classifications to address shortcomings of existing sensors and challenges posed by next-generation airborne threats. We achieve this through a holistic approach to target tracking and identification, seeking to relieve dependency on individual sensor units and to leverage all possible information of the battlespace, especially human level knowledge of sensor behavior, battlespace conditions, and enemy force. We find that Bayesian networks are favorable tools to encode domain knowledge and perform last-mile reasoning over any number of non-explainable black-box type approaches, producing more reliable, trustable, and interpretable results than any individual sensor.